Robotic Guards Protect Munitions

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Guarding the munitions at the Army's largest ammunition storage depot is a monumental task that requires a trained and dedicated guard force. Recently, this task has become easier with the addition of "robotic security guards." These security robots, tasked with detecting intruders, checking the status of locks on bunkers and tracking munitions via radio frequency identification (RFID) tags, are currently patrolling at Hawthorne Army Depot (HWAD), NV.

MDARS will revolutionize the Army's automated robotic intrusion detection and early response capabilities while enhancing physical security and freeing up Soldiers and civilians for higher priority missions. (Photo courtesy of General Dynamics Land Systems.)

Robotic Security System

The robots are part of the Mobile Detection Assessment Response System (MDARS), a Joint Army-Navy development effort to provide automated robotic intrusion detection, response and inventory/barrier assessment capabilities for use on DOD facilities. The Army Product Manager Force Protection Systems (PM FPS) manages the MDARS program. This program fulfills a critical capability identified by the U.S. Army Military Police School for installation security.

The MDARS' primary components are semi-autonomous unmanned ground vehicles (UGVs) and command and control (C2) software termed the Multiple Resource Host Architecture (MRHA). The Space and Naval Warfare Systems Command (SPAWAR), San Diego, CA, is developing the MDARS program's MRHA software and has successfully adapted it to other robotic applications. General Dynamics Robotic Systems, of Westminster, MD, is developing the UGV and is a subcontractor on the Army's Future Combat Systems program.

In addition, other associated items of equipment include the newest Navy high-security Internal Locking Device (ILD), RFID tags and associated RFID tag readers. The entire system is designed to provide a site with significantly enhanced physical security with minimal additional manpower demands.

MDARS Operations at HWAD

The MDARS deployed to HWAD in late 2004 consists of four UGVs, a C2 console installed in the Guard Operations Center (GOC) that runs the MRHA software and communications equipment. In addition, personnel installed ILDs and RFID tag readers on selected storage bunkers. RFID tags were mounted on critical products stored in those same bunkers. The MDARS program trained site personnel to perform numerous MDARS functions including system operations, administration and maintenance to include UGV pre- and post-patrol preventive maintenance checks and services.

During testing to date, the semi-autonomous UGVs have patrolled assigned portions of the depot (about 30 square miles) for 12 hours per day on weekdays and 24 hours per day on weekends. Their mission tasking includes intruder detection, monitoring and reporting the status of the ILDs on munitions bunkers, as well as tracking the presence/location of tagged munitions using active RFID technology.

HWAD personnel located in the GOC operate the MDARS C2 console. These personnel operate the system as an additional task along with their normal functions of guard operations, communications and intruder detection system (IDS) monitoring. During this test period, PM FPS representatives will periodically introduce selected events, such as intruders, obstacles in the robots' paths, opened locks and moved containers, to observe not only how both the system and users respond but also to observe whether the system control is user-friendly. In addition, the test plan introduced more than 75 exercise scenarios with the further objective of identifying other contributions that MDARS could provide in emergencies such as fires, hazardous materials accidents, communications outages and fixed IDS failures.

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In fact, depot personnel have used these robotic assets for actual mission needs to provide temporary short-term surveillance on incoming/outgoing staged munitions shipments that were not in IDS-protected structures, on storage structures experiencing temporary IDS failures and during increased threat level alerts where additional overwatch of an ammunition storage area was required.

Console Operations

The heart of MDARS is the C2 console and the MRHA software. One person operates the console, although two people can operate the system simultaneously if needed. In general, a system administrator will develop duty rosters, which are simple text files that assign what each robot will do during a patrol period. Generally, once a day, the console operator will start a duty roster and the appropriate UGVs will automatically be sent on patrol, to a defined location to perform sentry duty, or to the garage for periodic maintenance.

The system requires no manual intervention from the console operator unless problems arise or there are unplanned mission needs. If necessary, the console operator can take control of any UGV, send it to any location

Console operator Theresa Dillon monitors the status of a robot on patrol. During normal operations, robots require little human supervision. (Photo by Doriann M. Jaffee.)

and assign it to perform IDS, lock status checking and/or RFID tag reading. The console operator also has a joystick with which to take direct control of a robot's cameras or to drive it a short distance to any given position.

Intruder Detection

A primary mission of these robotic guards is intruder detection. The robots stop periodically during their patrols to scan for intruders using radar and infrared sensors. When the system detects a suspected intruder, it sends an alarm to the control station. The robot automatically points its onboard camera toward the intruder. A verbal command is issued by the robot, ordering the suspected intruder to "halt and be identified."

The console operator has a variety of options — use the UGV's onboard camera to scan the area and more fully assess the situation, communicate with the suspected intruder via microphones and speakers on the console and UGV, and/or require the person to show identification. If the suspected intruder is determined to be an authorized person, the console operator can identify him/her as "friendly" on the console screen. If necessary, the console operator can dispatch human guards to investigate and, if desired, another UGV to provide additional overwatch. Intruder detection has been quite reliable throughout the MDARS testing to date.

Lock Status Reporting

A number of the bunkers at HWAD have ILDs installed in their doors. Each heavy-duty lock has magnetic sensors that report the lock's status. During patrols, robots stop at each of these bunkers and read the current lock status. If the lock is open or reports an error, which could indicate the lock has been damaged or tampered with, an alarm is raised at the console. The console operator can then use the UGV's camera to assess the status of the door and lock. The operator can also dispatch human guards to the bunker to assess its condition and secure it.

Munitions Tracking Via RFID

One of the depot's critical functions is stored munitions inventory control. Historically, personnel have done this manually by inventorying the contents of each bunker either annually or semi-annually, depending on the priority of its contents. The MDARS product assessment feature provides a streamlined method for tracking these munitions. RFID tags are attached to pallets or containers. RFID tag readers store information on which tags are inside the bunker and when each was last read. When a UGV stops at one of these bunkers, it reads the information and transmits it to the central console.

Personnel in the accountability division have MRHA reports available to them that point out any discrepancies such as tagged items that are missing or not in their assigned locations. This provides near-real-time verification that munitions are present and in the correct locations. If an actual theft occurs, accountability personnel would be aware of the problem much sooner, and have much more information at their disposal, than in a strictly manual system.

Materiel Overwatch

During the receiving/shipping process, HWAD personnel often place munitions in an exterior loading dock area for some period of time. Security

The MDARS console display shows an image, taken at night, from the infrared camera of one of the robots on patrol. The heat signatures of four persons sitting in a truck can be clearly seen by the console operator. (Photo by Doriann M. Jaffee.)

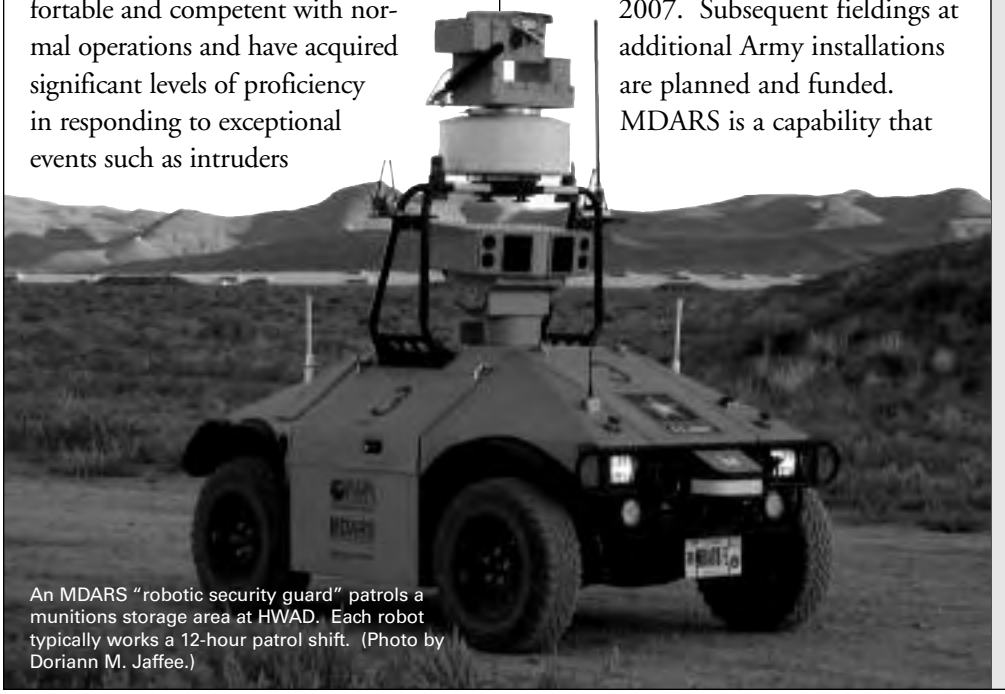
MDARS is playing an important role at Army depots and arsenals by providing intrusion detection intervention, lock status checking and RFID tag reading. (Photo courtesy of General Dynamics Robotic Systems.)

procedures require a 24-hour overwatch while munitions are stored at the dock. Until now, this has required using a fixed IDS, if available, or posting one or more guards at these areas. The MDARS robots are now being used regularly to provide materiel overwatch at dock areas without an IDS. This eliminates the need for human guards, who are now available to respond to higher priority situations.

Accomplishments to Date and the Future

Over the course of the system assessment to date, the four UGVs have patrolled in excess of 3,500 hours and traveled more than 12,500 miles. System operators have become very comfortable and competent with normal operations and have acquired significant levels of proficiency in responding to exceptional events such as intruders and open locks. Automated product tracking using RFID tags has been found to be highly reliable, giving near-real-time notification of inventory discrepancies. Most importantly, both robot and MRHA developers have gained valuable real-world data on hardware and software performance as well as potential areas for improvement.

Given the complexity of fielding a semi-autonomous unmanned system, these are significant achievements in the area of robotic physical security. MDARS will substantially enhance the force protection posture of any government installation. The MDARS program is on track to begin fielding a production system at HWAD in late 2007. Subsequent fieldings at additional Army installations are planned and funded. MDARS is a capability that shows potential for future growth in many other areas, from reconnaissance to logistics.



An MDARS "robotic security guard" patrols a munitions storage area at HWAD. Each robot typically works a 12-hour patrol shift. (Photo by Doriann M. Jaffee.)

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